Light-Duty Vehicle Choice Modeling and Benefits Analysis (van018)

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OVERVIEW

Timeline

| FY20 $300,000 | FY21 $300,000 | FY22 $300,000 |

BARRIERS

Addresses need to assess program benefits and inform portfolio planning related to:

- Advanced Combustion
- Electrification Technologies
- Batteries
- Material Technologies
- Fuel Cells and Hydrogen Storage.

PARTNERS

- DOE program technology managers for each technology area (shown in Barriers section above)
- Input from industry through U.S. DRIVE.

RELEVANCE

Objectives:

- Estimate the emission and energy benefits of vehicle technology research
- Help inform program goal-setting, identifying the varying benefits expected from different levels of technology progress
- Support diverse decarbonization pathways, including through vehicle electrification, advanced combustion, lightweight materials and hydrogen fuel cells

SUMMARY

- Objective: Find technology improvement pathways to light-duty decarbonization
- Updating technology and scenario assumptions with DOE technology managers and industry
- Simulate the technology assumptions in ADOPT
- Estimate the energy and carbon emissions benefits
- Iterate on the process to help inform assumptions and scenarios.

APPROACH

Acquire assumptions from the Vehicle Technologies Office (VTO), Hydrogen and Fuel Cell Technologies Office (HFTO), and Bioenergy Technologies Office (BETO) technology managers

- No Program assumptions
- Program Success assumptions
- Additional decarbonization scenario assumptions
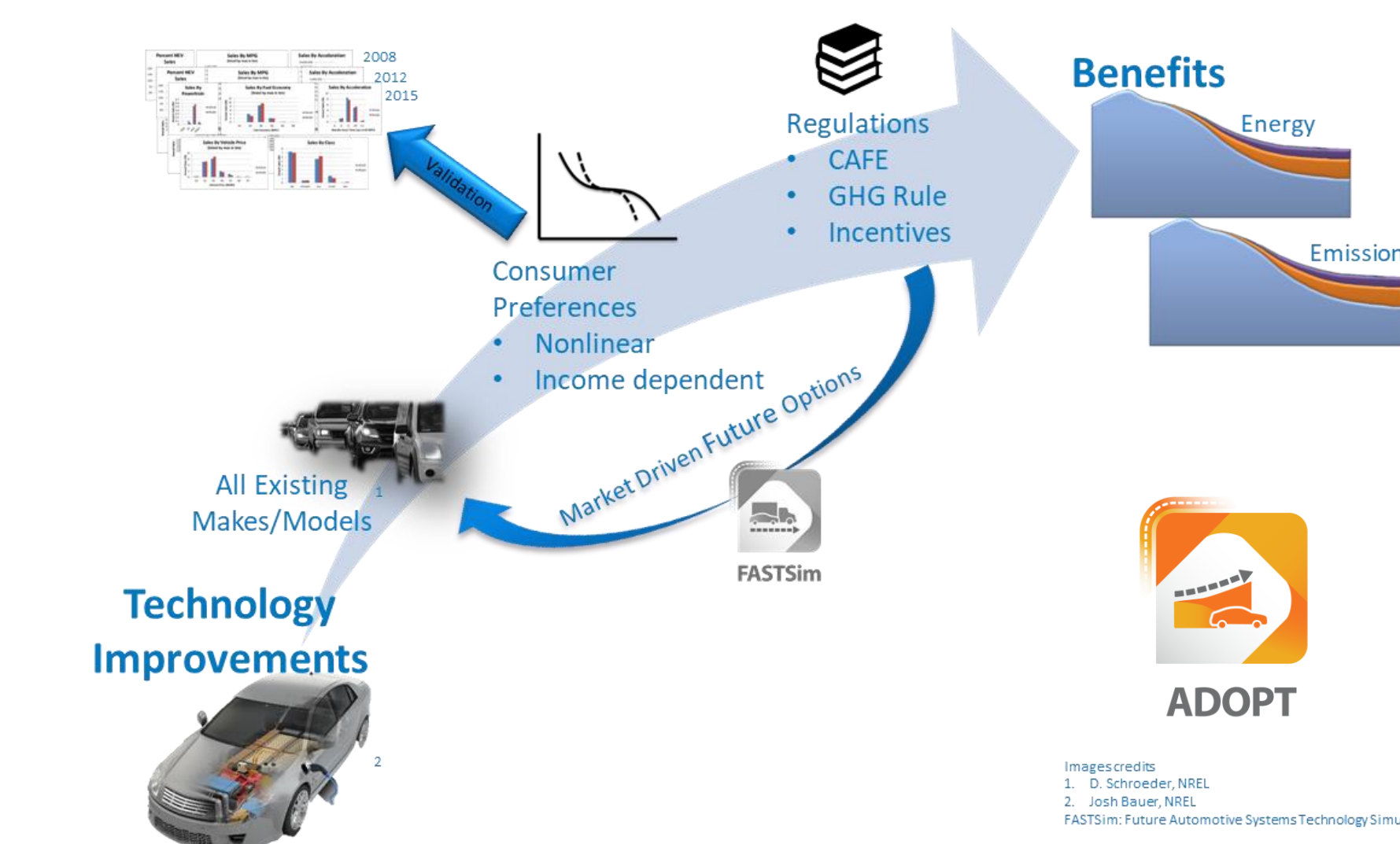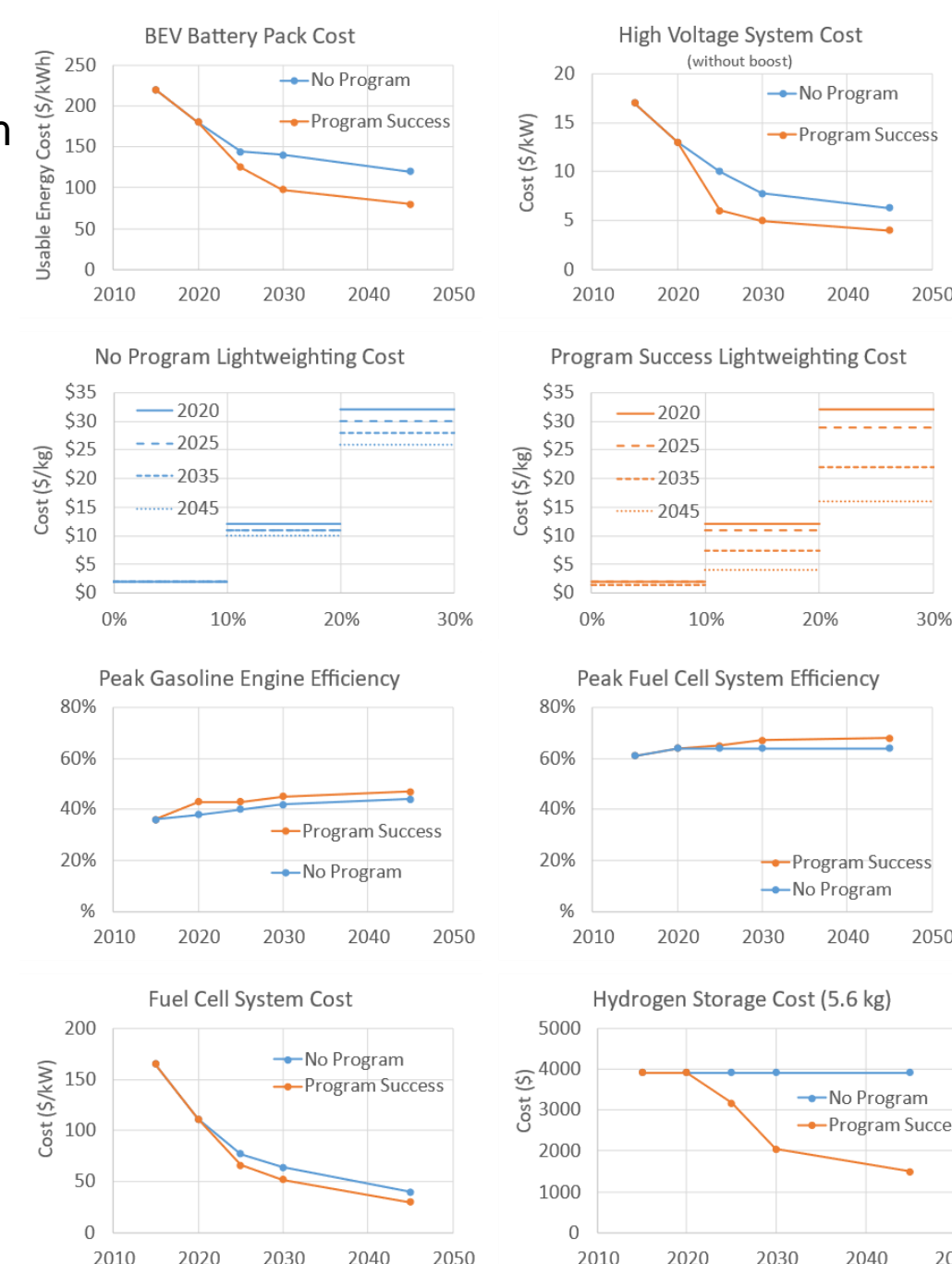
Input the scenario assumptions into the Automotive Deployment Options Projection Tool (ADOPT) to estimate program benefits for light-duty vehicles. ADOPT is a vehicle choice and stock model that estimates vehicle technology improvement impacts on sales, energy, and emissions. It includes all existing vehicle options for realism, estimates their sales using extensively validated consumer preferences, creates new market-driven vehicle options through time, and rolls up sales to estimate energy and emissions.

ACCOMPLISHMENTS AND PROGRESS

Validated ADOPT's ability to match past sales trends, providing confidence in the tool

Matches historical sales trends

ADOPT simulations start in 2015, and the model's sales estimates are consistent with historical sales trends since then, providing confidence in the validity of future year sales estimates. ADOPT accurately captures how sales during this time remained primarily conventional gasoline vehicles, with some hybrid electric vehicles (HEVs) and small numbers of battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs).
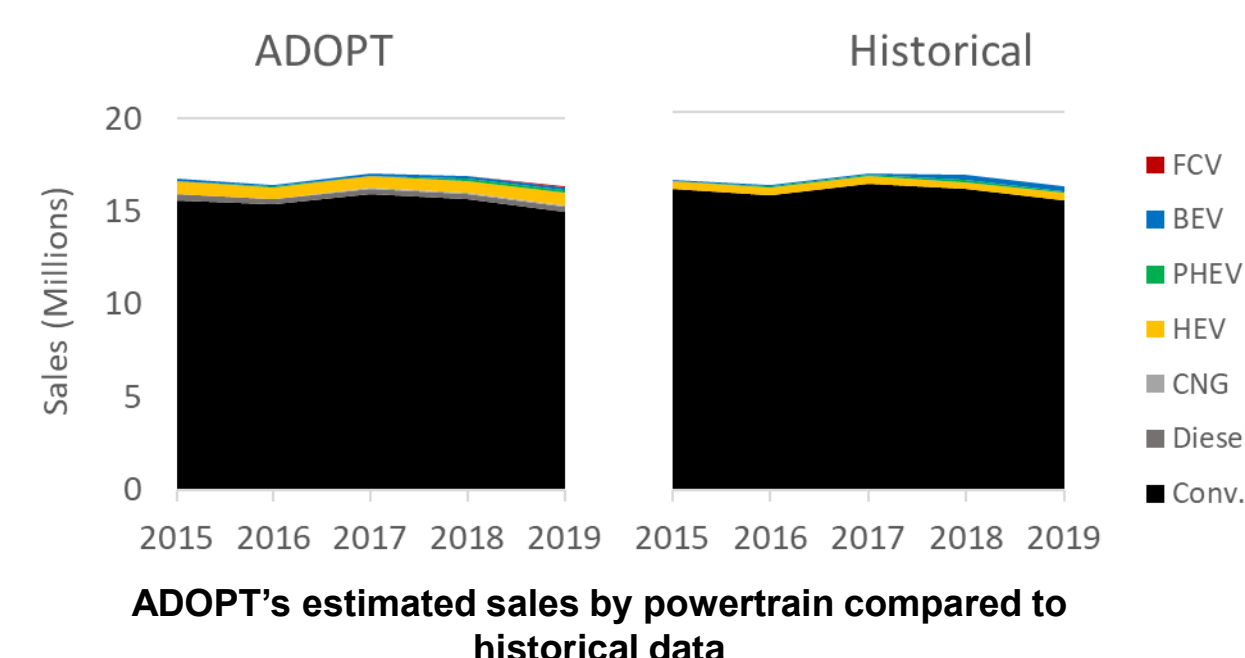
ADOPT's estimated sales by powertrain compared to historical data

Y. Zhou, U.S. Light Duty Electric Drive Vehicles Monthly Sales Update, March 2021, Argonne National Laboratory, 2021.

Matches who has bought PEVs

ADOPT results also match data showing plug-in electric vehicles (PEVs) selling primarily to high-income households. ADOPT's ability to accurately estimate the income distributions of current PEV purchasers lends further confidence that the model is accurately representing consumer preferences.
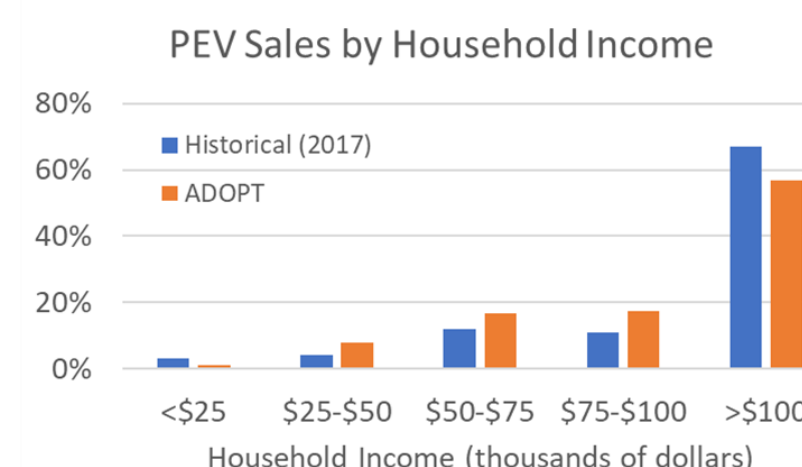
ADOPT PEV sales estimates compared to historical data on the income distribution of electric vehicle owners

https://www.eia.gov/todayinenergy/detail.php?id=36312.

Estimated future advanced vehicle sales, plus associated energy & emissions benefits from further technology progress
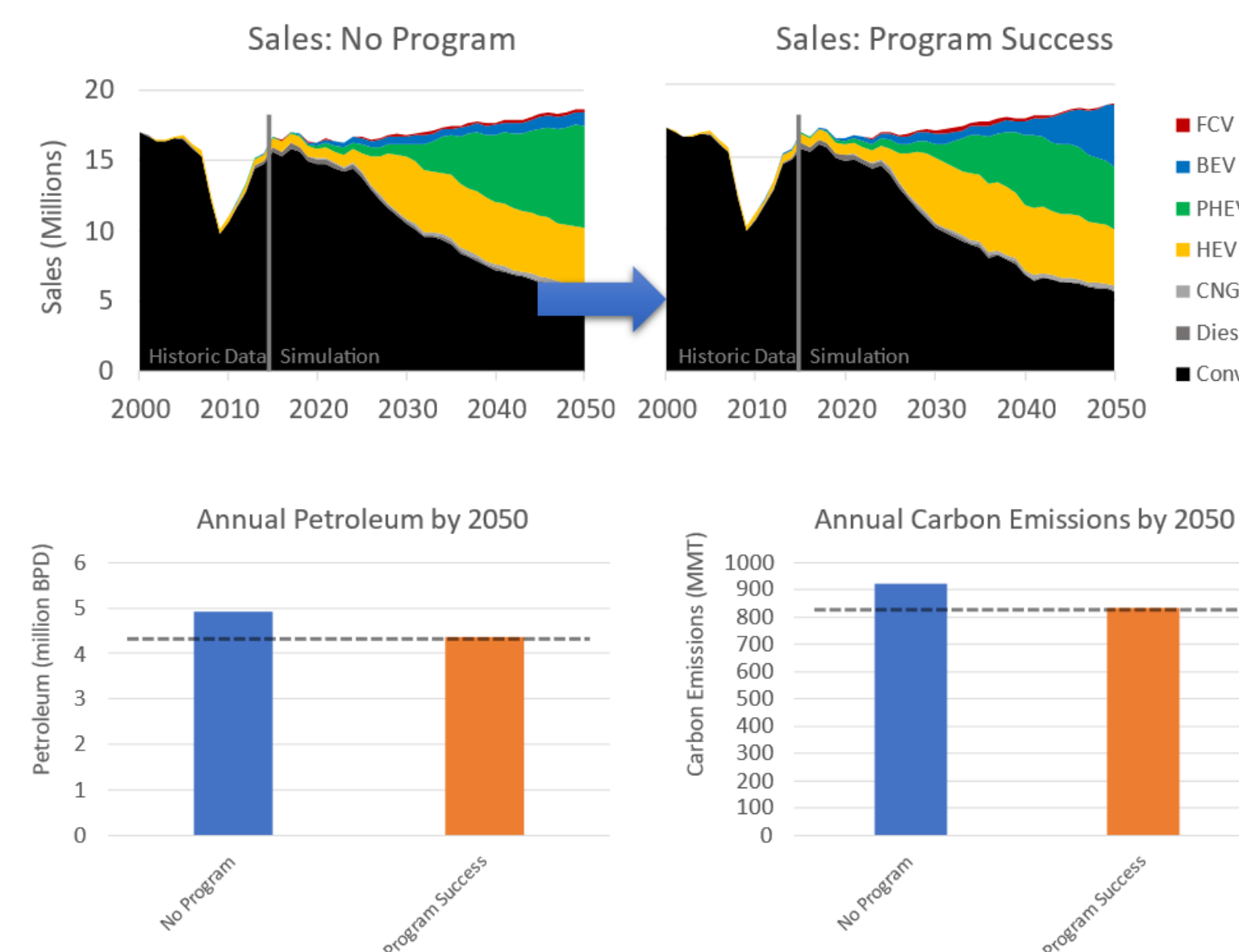
CHALLENGES AND BARRIERS / FUTURE WORK

Find pathways to decarbonization

- Estimate different technology improvements that lead to rapid light-duty vehicle decarbonization
  - Battery cost reductions
  - Fuel cell and hydrogen storage improvements
  - Alternative fuels and advanced combustion
- Assess pathway sensitivity to market conditions, such as different fuel prices and potential policies
- Continue iterating on assumptions and scenarios with technology managers and industry.

Proposed ADOPT improvements

- Capture home charging availability influence on plug-in electric vehicle purchase decisions
- Improve simulation speed by completing link to a Python version of the Future Automotive Systems Technology Simulator (FASTSim), which has shown 20–100x speed improvement.

Any proposed future work is subject to change based on funding levels

COLLABORATION AND COORDINATION

Ongoing coordination with VTO, BETO, and HFTO technology managers and U.S. DRIVE members to discuss

- Technology assumptions
- Regulatory assumptions
  - Corporate Average Fuel Economy (CAFE)/ greenhouse gas standards
  - Zero-emission vehicle mandates
- Interim and final analysis findings

Collaborate with related VTO-funded "Medium- and Heavy-Duty Vehicle Choice Modeling and Benefits Analysis" effort, along with complimentary HFTO- and BETO-funded activities

DOWNLOAD ADOPT

ADOPT is available for free download at: **www.nrel.gov/adopt**